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AUTHOR Olmstead, Jodi L.

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ABSTRACT

The academic performance of students enrolled in a distance education dental hygiene program at Northcentral Technical College (NTC) in Wausau, Wisconsin, was analyzed in a comparative, quasi-experimental study. The study sample consisted of five cohorts of program graduates (students graduating in 1997-2001). The experiment groups were divided based upon whether they pursued the program at the host college or one of the cooperating college (distance) sites with which NTC shares its dental hygiene program. The achievement of the learners at the host and cooperating college sites was compared based on their grade-point averages (GPAs) and their performance on the National Board of Dental Hygiene Examination (NBDHE). No statistically significant differences between the scores achieved by the two groups of learners on the NBDHE were identified. Neither were any significant differences between students' GPAs in 10 of the 11 core dental hygiene courses found. It was concluded that the distance educational technology of interactive television used in NTC's dental technology program resulted in acceptable levels of learner performance. (Contains 43 references. Appended are a listing of dental hygiene core curriculum courses, the NTC grading scale, and 17 tables summarizing the two groups' performance in core courses.) (MN)

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# LONGITUDINAL ANALYSIS OF STUDENT PERFORMANCE BETWEEN HOST AND COOPERATING COLLEGE LEARNERS IN THE DENTAL HYGIENE PROGRAM AT NORTHCENTRAL TECHNICAL COLLEGE IN WAUSAU, WISCONSIN

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By
Jodi L. Olmsted

A Research Paper

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Approved: 6 Semester Credits

Howard D. Lee
Field Study Chair
Field Study Committee Members:

Amy L. Hillett

Richard D. Bowen

Michael J. Galloy

The Graduate College
University of Wisconsin-Stout
August, 2001
The Graduate College

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University of Wisconsin-Stout
Menomonie, Wisconsin 54571

## ABSTRACT

Olmsted Jodi L.
(Last Name) (First) (Initial)

(Title)

LONGITUDINAL ANALYSIS OF STUDENT PERFORMANCE
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IN WAUSAU, WISCONSIN

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Little research had been done in the area of learner performance using distance education methodology. Research had instead focused primarily on learner satisfaction with the use of the medium. There was a need for additional research in the area of learner performance while using distance education delivery methodology.

A comparative, quasi-experimental, ex-post facto study was conducted. The treatment variable was time. Since original research conducted in 1996, there had been five cohorts that had graduated, the classes of 1997, 1998, 1999, 2000 and 2001. The experiment groups were divided based upon location-host or cooperating college (distance) site learners. All data necessary to conduct the study already existed in the registrar's office at Northcentral Technical College. The purpose of the study was to determine if the learners who are face-to-face (host) performed statistically better on established benchmark assessments (GPA & NBDHE) than learners at a distance.

Study results identified no significant difference between host and distance learner performance for an entire educational program. The delivery of an educational program using distance education technology, specifically interactive television (ITV), provided acceptable results in learner performance. Learners at both the host and cooperating college (distance) sites performed equally well. Results were used to document program outcomes, and were reported to the American Dental Association Commission on Dental Accreditation to assist in determining the effectiveness of learner performance while using distance education as a delivery mechanism.

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# CHAPTER ONE

## Introduction

Distance Education is a fact of life for the new millennium. In an Internet search for distance education programs related to dental hygiene, there are over 2900 websites (Yahoo, 2000). The dental hygiene program at Northcentral Technical College (NTC) in Wausau, Wisconsin (WI) is one of the programs that can be found in this type of Internet search. Northcentral Technical College is one of the 16 technical colleges that comprise the Wisconsin Technical College System (WTCS), and one of the six dental hygiene programs that exist in the State of Wisconsin. The six dental hygiene programs within the state include: Marquette University (the only school not in the WTCS system); Northeast Wisconsin Technical College in Green Bay; Madison Area Technical College in Madison; Milwaukee Area Technical College in Milwaukee; Waukesha Area Technical College in Pewaukee; and Northcentral Technical College in Wausau. Additionally, Waukesha Area Technical College shares their dental hygiene program with Gateway and Blackhawk Technical Colleges in Racine and Janesville, respectively, while Northcentral Technical College shares it's dental hygiene program with Colby Community College (CCC) in Colby, Kansas; Chippewa Valley Technical College (CVTC) in Eau Claire, Fox Valley Technical College (FVTC) in Appleton, and Western Wisconsin Technical College (WWTC) in LaCrosse. The dental hygiene consortium that exists in the state of Wisconsin allows dental hygiene education delivery in 11 of the 16 WTCS schools.

The dental hygiene program at NTC has been in existence since 1980. NTC offers its learners an Associate of Applied Science Degree in a two or three-year curriculum sequence, depending on the cooperating college school the learner attends. NTC-Wausau, CCC-Colby, CVTC-Chippewa Valley, and WWTC-Western Wisconsin all follow a two-year curriculum sequence. FVTC-Fox Valley follows a three-year curriculum sequence, allowing their attendees the option of attending the program on a part-time basis.

The dental hygiene program curriculum consists of both general education and occupational specific courses in a sequence that builds from simple to complex, with increases in scope and depth of course content. Learners at each cooperating college take the general education course requirements at their home campus. Dental hygiene course sequencing follows a pre and co-requisite pattern that allows the learner to develop cognitive, psychomotor, and affective skills while providing dental hygiene treatment and care both safely and responsibly. This educational sequencing prepares the learner for basic, entry-level dental hygiene positions in the workforce upon graduation.

The program curriculum consists of a core of occupational specific courses including: Oral Anatomy & Histology, Dental Radiography, Preclinical Dental Hygiene, Dental Materials, Periodontology 1, Clinical Dental Hygiene 1, Periodontology 2, Clinical Dental Hygiene 2, Community Dental Health 1 & 2, General & Oral Pathology, Pharmacology, Dental Practice Management, and Clinical Dental Hygiene 3. Supportive electives for the program include: Pain Management and Dental Hygiene Transition into Practice. Courses were developed following guidelines set by the American Dental

Association Commission on Dental Accreditation (ADA CODA). While these guidelines are broad in nature, they establish minimum standards for dental and dental hygiene education (Accreditation Standards for Dental Hygiene Education Programs, 1999).

During the early 1990's, the dental hygiene program at NTC was in jeopardy of closing its doors. The program had high operating costs caused in part because accreditation guidelines set by the commission (CODA) required a one to six clinical faculty to student ratio. Laboratory courses had one to 15 ratio restrictions, while didactic course enrollment was limited only by program size restrictions. These ratio requirements continue to exist in dental hygiene education. It was recognized at the time there was a "shortage" of qualified dental hygienists in other areas of the state (Budjac & Daily, 1995). Northcentral Technical College began exploring "program sharing" within the state of Wisconsin. By sharing the dental hygiene program with other technical colleges within the state, NTC addressed two problems at once- 1) reduction of program costs by "sharing" them with any other colleges whom wished to enter into a program sharing agreement, and 2) meeting market demand through supplying dental hygienists in other parts of the state where there were manpower shortages. Program sharing requires following specific Wisconsin Technical College System (WTCS) guidelines (WTCS Educational Services Manual, 2000) which establishes high quality educational standards.

In 1992/1993, program-sharing investigation began at NTC. Those parties preliminarily interested in pursuing a program sharing agreement for dental hygiene education along with NTC included Chippewa Valley Technical College, Fox Valley Technical College, and Indianhead Technical College. Indianhead Technical College

dropped out of program investigation early on, and Chippewa Valley Technical College and Fox Valley Technical College became the first two cooperating colleges to begin program sharing in 1993 with NTC. Western Wisconsin Technical College began program sharing with NTC in 1994, and Colby Community College in Colby, Kansas joined the shared program in 1998.

Northcentral Technical College was the first program in the nation to deliver its entire dental hygiene curriculum via the use of distance education technologies in 1993. When NTC began program sharing with Colby Community College in Colby, KS in 1998, it also became the first program in the country to share dental hygiene education across state lines.

NTC dental hygiene program sharing occurs with its cooperating colleges by using distance education -specifically- Interactive Television (ITV). This distance education instructional medium allows for the delivery of didactic courses over a two-way, fully automated, fiber optic network.

In the program-sharing model, NTC is the originating, or "host" school. NTC delivers all didactic courses for the dental hygiene curriculum to the learners at the cooperating colleges. The delivery mechanism for the shared dental hygiene didactic content is a fully functional, full range, two-way auditory and visual medium. The distance education interactive television system (ITV) allows for direct, synchronous learning to occur in real time. A learner can see, hear, and interact with the class facilitator and their classmates from all of the other cooperating colleges. The medium uses a fiber optic network consortium in the state of Wisconsin known as WONDER (Wisconsin Overlay Network for Distance Educational Resources), and to Kansas

through the use of a dial up ISDN (Integrated Service Digital Network) and a video CODEC (Coder/decoder) compressed digital phone line. Six phone lines are used to send the audio and visual signals between the two states.

Dental hygiene program sharing at NTC operates in the following way. NTC holds program accreditation. NTC is the originator of the entire dental hygiene curriculum. Learners at each cooperating college take the general education course requirements at their home campus. The dental hygiene program shares curriculum with the cooperating colleges. All dental hygiene didactic courses originate from NTC, and are delivered over Interactive Television (ITV) by NTC faculty. Cooperating colleges hire faculty to work in collaboration with NTC faculty to teach the laboratory and clinical courses. Faculty follows the clinic and laboratory performance guidelines developed by NTC. All evaluation and grading mechanisms, paperwork and clinical forms are the same at each of the cooperating colleges. The courses having laboratory and clinical components require faculty team calibration meetings. Calibration occurs through several face-to-face meetings per year, the use of faculty laboratory manuals, and weekly or bi-weekly telephone conference calls. Calibration ensures learners have the same experiences in all laboratory and clinical courses at the cooperating colleges. These calibration meetings allow for problem solving, developing, and modifying curriculum to assure its currency and relevance. Brainstorming new ideas also occurs.

Sharing of the dental hygiene program with the cooperating colleges needed to be a "win-win" for everyone concerned. The learners get the education at their cooperating college without needing to relocate or commute significant distances for, the cooperating colleges have reduced costs by program sharing rather than starting their own programs.

and the schools share full-time equivalencies (FTE's). To make dental hygiene program sharing a "win-win" for all institutional stakeholders, NTC gets the FTE's for the lecture courses. The courses with laboratory components share FTE's between the host and cooperating college school. For those courses that are strictly clinical, the cooperating college school gets the FTE's. In an analysis of the curriculum (NTC College Program Catalogue, 1999-2001) dental hygiene students must complete 72 credits to complete their Associate of Applied Science (AAS) degree. Within the 72 credits required in the program, the "core" dental hygiene curriculum consists of 37 credits in the program. The program credits are "split" between NTC and the Cooperating Colleges, 19 of them going to the "host" Institution-NTC, and 18 of them going to the cooperating college school (NTC Dental Hygiene New Student Orientation Handbook, 2000). The cooperating college school gets all FTE's associated with general education courses (NTC program sharing credit splitting chart, 1993).

The lead course instructors, who originate instruction from NTC, are responsible for initiating all testing, ensuring consistency with laboratory grading, and computing final course grades. Faculty responsible for clinical courses at each cooperating college use a computer grading program developed for use specifically by NTC's shared program (DHCMS, 2000) to ensure grading consistency following clinical evaluation.

Dental Hygiene programs are accountable for their outcomes and must report them to the Commission (Accreditation Standards for Dental Hygiene Educational Programs, 1998). When learners graduate from a dental hygiene program, they must take a National Board of Dental Hygiene Examination (NBDHE). Learners must pass this national, norm-referenced assessment at 75% before being licensed to practice dental

hygiene (American Dental Association National Board Dental Hygiene Examination Booklet, 2001). This nationwide benchmark assures quality dental hygiene health care within the profession. This benchmark is also used as an indirect measure of program effectiveness. Other benchmarks for program effectiveness include comparisons of grade point averages (GPA's) and student academic performance in individual courses (i.e., grades). The Carnegie Council (1977) considers GPA's a predictor of future academic performance. GPA's are considered reflections of motivation and excellence in schoolwork (Carnegie Council, 1977). At NTC, grades are assigned following a standard four point scale- an A= 4.0, A- = 3.67, B+=3.33, B- =3.0, C+ = 2.67, C =2.0, C- =1.67, D+ =1.33, D- =1.0 and F =0. Within the dental hygiene program, a straight 100% scale is used consistently for grading in all of the dental hygiene courses. Minimal competency for learner performance is 75%, and learners achieving less than 75% must complete retake quizzes or examinations to meet the minimum standard (NTC Course Manuals/Syllabi, 2000). Course grades achieved within the program are based on the straight 100% scale are then converted to the standard four point scale for computation of Grade Point Averages (GPA's). All test bank questions for each program content area are assessed for validity and reliability within each course. Accordingly, student grades and GPA's should be indicators of success for each course in the program.

Additionally, learners in the NTC shared dental hygiene program need to demonstrate the development of five defined program graduate competencies prior to graduation. The five program graduate competencies include: 1) Meet the dental health needs of individuals and groups; 2) Customize and proceed with emergency care protocol based on recognizing symptoms of medical/dental emergencies; 3) Utilize current

infection control guidelines and safety precautions in all laboratory and clinical settings; 4) Apply principles of dental practice management as a member of the dental health team; and 5) Demonstrate ethical and professional behavior in all roles as a dental hygienist. Demonstration of these competencies through the use of a Graduate Portfolio is a direct measure of student academic achievement. This graduate portfolio use is one of NTC's outcome tools to document learner achievement. The learner must keep his/her portfolio documenting personal development of the graduate competencies throughout the entire two or three years they are in the program. The learner also must complete an in depth self-analysis, with input from his/her academic advisor, of his/her portfolio contents. If upon self-analysis learners find themselves lacking in the program competency areas, they must develop a remediation plan outlining developing the deficient skill area prior to graduation.

Northcentral Accreditation (NCA), which is an accrediting body for post-secondary schools, also requires documentation supporting student assessment. The graduate portfolio the learner develops in their tenure with the dental hygiene program is considered a to be a measure of both formative and summative knowledge, skill and behavioral development. While this tool documents student success within the program it does not critically evaluate performance through statistical analysis.

While considerable study had occurred regarding user satisfaction and the evaluation of teaching effectiveness and methodology for educators using distance education technology, little research had been done on student success (Bergman, 1994; Cralley, 1996) using this medium. More research in this area was necessary.

Statement of the Problem

Dental Hygiene programs continue expanding by using distance technology to deliver education to cooperating colleges located at a distance from the originating school. While considerable study has occurred regarding user satisfaction and the evaluation of teaching effectiveness and methodology for educators using distance education technology, specifically the use of Interactive Television (ITV), little research has been done on student success (Bergman, 1994; Cralley, 1996) using this medium. There was a need for additional research on student performance. Completion of a comparative, longitudinal study at Northcentral Technical College would assess if National Board of Dental Hygiene (NBDHE) scores, course grades, and GPA's were still indicators of program effectiveness for delivery of dental hygiene distance education.

Purpose of the Study

The purpose of this study was to determine if distance learners who graduated from Northcentral Technical College since initial research in 1996 (Cralley, 1996) performed statistically better on the National Dental Hygiene Board Examination (NBDHE) and had higher grade point averages (GPA's) than those learners who are face-to-face at the originating site (NTC). The study variable was time - five graduating classes had completed the program since the original study's cohort. Data collected included ages, individual course and cumulative grade point averages, and National Board Dental Hygiene Examination (NBDHE) scores. This data was collected confidentially from the registrar's office at Northcentral Technical College in Wausau, Wisconsin, during the spring and summer of 2001.

Research Hypotheses

Hypotheses examined during this study included the following:

1. No statistical difference in performance on the National Board of Dental Hygiene Examination (NBDHE) existed between cooperating college and host college learners.
2. No statistical difference in grades for core curriculum courses existed between cooperating college and host college learners.
3. No statistical difference in grade point averages (GPA's) existed for cooperating college and host college learners.
4. No statistical difference existed between previous research findings (Cralley, 1996) and current field study findings using Interactive Television (ITV) for the delivery of dental hygiene education.

Significance of the Study

The significance of this study was to continue examining the effectiveness of using distance education technology to deliver dental hygiene education. Additionally, this field study repeated previous research methodology in the area of student performance on known academic benchmarks (Course grades, GPA's and NBDHE). Distance education methodology, specifically interactive television (ITV), was used to deliver the didactic content of an entire academic program.

Assumptions

Assumptions for this study included:

1. All evaluation instruments were free of bias in their format.

2. NBDHE scores achieved were true measures of learner knowledge, and not elevated or deflated based on extraneous factors.
3. Overall NBDHE scores were accurate, direct measures of learner performance.
4. Course grades assigned learners were true measures of their achievements, and not elevated or deflated based on extraneous factors.
5. Overall GPA was an accurate, direct measure of learner performance.
6. All learners who completed the program from all campuses were part of the study.
7. The procedures for administration of the testing instruments were within the guidelines written by the administrators of the testing instruments.

Limitations

Limitations for this study included:

1. Learner satisfaction with the use of the delivery medium (ITV) did not occur, as the study focus was on statistical analysis of performance rather than satisfaction with the delivery medium.
2. Learner evaluation of satisfaction with facilitator educational methodologies did not occur, as the study focus was on statistical analysis of performance rather than satisfaction with the facilitator's educational methodologies.
3. Facilitator attitude, or attitudes of facilitators at any of the participating cooperating colleges' schools, did not cause variation in learner performance.
4. Class attrition evaluation did not occur during this field study.

5. Only students enrolled in the dental hygiene program at Northcentral Technical College and its cooperating colleges were subjects of this field study. No other dental hygiene distance education program was evaluated.
6. The field study cohort was limited to the NTC dental hygiene graduating classes of 1997, 1998, 1999, 2000 and 2001.
7. National Board Dental Hygiene Examination data was limited to learner's first attempted score on the test instrument. Examination retake results were not included in the field study data.
8. No attempt to assess learner or facilitator satisfaction with the curriculum was made during this field study.
9. No attempt to assess or evaluate students' personal situations was made during this field study.
10. Data did not include individuals who did not graduate.
11. No attempt to determine if facilitator-grading strategies occurred.
12. No attempt was made to determine if differing facilitators graded individual course content differently.

Definition of Terms

Terminology used throughout this study is defined for the reader.

CODA- Acronym for Commission of Dental Accreditation, the body who oversees and administers Accreditation Standards for Dental Hygiene Education Programs.

Cooperating College- Campuses that share the dental hygiene program with Northcentral Technical College; each delivers the laboratory and clinical components of the curriculum on their campus using NTC curriculum. The cooperating colleges include:

CCC- Acronym for Colby Community College, located in Colby, Kansas.

CVTC - Acronym for Chippewa Valley Technical College, located in Eau Claire, Wisconsin.

FVTC - Acronym for Fox Valley Technical College, located in Appleton, Wisconsin.

WWTC - Acronym for Western Wisconsin Technical College, located in LaCrosse, Wisconsin.

Curriculum- An aggregate of courses in a specified program or school.

Distance Education- Educational programming provided to learners whom are geographically separated from the course facilitator.

Distance Site- a classroom geographically separated from the instructor equipped with Microphones, television monitors, cameras, computers, FAX machines, and other educational tools where learners can participate in learning activities as designed by the course facilitator.

FTE-Acronym for Full Time Equivalency, a measure of how many learners are enrolled in an academic program.

GPA- Acronym for grade point average, on a 4 point scale 4=A, 3=B, 2=C with the minimal Competency for a C at 75% i.e.: 70% is a C-, and not a passing score.

Host Site- a classroom equipped with microphones, television monitors, cameras, computers, FAX machines, and other educational tools where learners can participate in learning activities the course facilitator conducts activities from this location.

ITV - Acronym for interactive television, a delivery mechanism used by the dental hygiene program for educational delivery, the process by which two or more sites that is geographically separated are linked. Two way audio graphic and visual signals allow interaction between learners and the course facilitator. All participants can be seen and heard synchronously, and can respond to one another-see WONDER .

NBDHE - Acronym for the National Board of Dental Hygiene Examination, a norm-referenced based testing instrument. This test is used before graduation from an accredited dental hygiene school. Passing score required for this examination is 75%.

NTC - Acronym for Northcentral Technical College, located in Wausau, Wisconsin; home campus for delivery of didactic dental hygiene shared curriculum.

WONDER - Acronym for Wisconsin Overlay Network for Distance Education Resources the interactive, two-way visual and auditory delivery mechanism used to deliver the dental hygiene program to the cooperating colleges.

# CHAPTER TWO

## Review of the Literature

Distance Education has been used for years. Correspondence courses were the first form of distance education. Since then, the use of computers, fiber optic systems, satellites, cable and microwave systems, and interactive television fined service (ITFS) have been used as delivery systems for distance education (Dickerson, 1987). This chapter reviews the literature documenting learner performance using distance education technology, while examining the role of distance education to deliver education in the allied health fields and, more specifically, dental hygiene education.

### Historical Perspective-Learner Satisfaction

Learner satisfaction while using distance education technology as the delivery system has undergone a significant amount of research. Most literature identified documenting distance education technology revolves around learner satisfaction with the use of the medium (Brecke, 1997; Brown, 1996; Decker, 1992; Hunsanger, 1990; Jones, 1991; Silvernail & Johnson, 1992; Simmons, 1991). These studies all documented learner attitudes with the use of the delivery system. The majority of the studies reviewed showed learner attitudes tended to be positive, and they reported high levels of satisfaction with their learning.

Brown (1996) reported that of the fifty-one learners surveyed at Wisconsin Indianhead Technical College regarding the use of Interactive Television, most regarded the instructor and class favorably, however, cited frustrations with the failure of equipment-which translated into loss of class time. These persons felt ITV was a viable

alternative to traditional education as they could take course closer to home, had smaller class sizes and had fewer class cancellations. Brecke's (1997) study of the NTC dental hygiene program found the learners were not necessarily happy with the delivery medium for their education, but felt they did receive a quality education, nonetheless. Learners were dissatisfied with the quality of the medium and reported technical "glitches" interfered with their learning. These glitches included loss of picture and sound, "break ups" during transmission, which resulted in the student's perception of lost information that was not received. Brecke also noted a concern for lost class time when using the medium. Other dissatisfaction was noted with reporting of the feeling of disconnectedness with the host site instructor, and their lack of availability. These cited studies did not focus on actual learner performance, but instead focused upon learner satisfaction with the delivery medium.

Learner Performance - An Overall Evaluation

It has long been believed that grade point average (GPA) is a predictor of future academic performance (Carnegie Council, 1977). Carnegie Council (1977) also reflected GPA's indicated learner motivation, and performer excellence as documented by outstanding grades. Does comprehensive testing provide evidence of long-term development of learners? Research has shown that objective examinations such as the American College Testing Program (ACT), the Scholastic Aptitude Test (SAT), and the Allied Health Aptitude Test (AHAT) do provide support of student long-term academic development while predicting student aptitudes (ACT, 1999; Carnegie Council, 1977). However, these testing mechanisms are not foolproof, and often do not accurately predict student aptitudes, abilities or interests. Student success and academic achievement is a

primary goal of the majority of academic institutions. Many standardized testing mechanisms have been used to measure student aptitude prior to admission to institutions of higher learning. Another measure often used is student grade point average (GPA). The uses of both these types of mechanisms have inherent strengths and weaknesses. Objective testing mechanisms can be used to represent student cognitive ability; which is developed over time. These tests can be applied in a wide variety of circumstances, across diverse student groups, and in many different curriculum areas (Carnegie Council, 1977). GPA is recognized as an indicator of student motivation, however, an apparent weakness lies within its' comparability within schools, departments and classes (Carnegie Council, 1977).

Predictors for student academic success have been observed when there is more than one of these variables taken into account. Historically, the use of several of these factors (objective testing mechanisms and GPA) is the best predictor for student academic success, and is often used within the student selection process for admissions into institutions of higher education. Life experiences and motivation are examples of other predictors, which can contribute to student success. Breland (1979) stated that criterion can be biased without factoring in these other areas of student performance.

Olmsted (1996) identified correlational relationships between first, third and cumulative GPA and the learner performance on the NBDHE. Investigation revealed strong correlation between cumulative GPA (0.7), third semester GPA (0.63) and first semester GPA (0.6) and learner performance on the NBDHE. Once learners are admitted to the dental hygiene program their performance, as demonstrated by their GPA, could potentially indicate their ability to be successful on the NBDHE. This predictive validity

is considered when evaluating the program for its effectiveness. The shared dental hygiene program at Northcentral Technical College recognizes GPA's are indicators for predicting student success, and ultimately, program effectiveness. Survey results and yearly passage rates are examined as one measure to document program effectiveness and outcomes. Since 1997, the dental hygiene program has had a 100% passage rate (Classes of 1997, 1998, 1999, 2000, 2001) on the National Board Examination, with a 96%, 93%, 87%, 95%and 91% passage rate during the first writing of the examination, and anyone whom needed to repeat the examination (in all five cohorts) were successful on the second examination.

Learner Performance - A Distance Delivery Evaluation

The use of learner performance using distance education as an educational delivery system was the focus of this study. The impact of learner performance can be reflected by academic achievement (GPA) and performance on benchmark tests while receiving education using distance educational delivery systems. Review of the literature found the majority of studies showed no significant difference in student performance based on student location or the delivery mechanism used.

Kabat and Friedel (1990) identified learner performance between host and distance sites were not significantly different. Their study focused on six variables: 1) system use; 2) class enrollment; 3) grade point averages per site; 4) student evaluations of the learning system; 5) evaluation of dropouts; and 6) instructor evaluation. Their study used a t-test to determine that learner performance was not impacted by distance education.

While Morehouse (1987) was evaluating ITV systems in Minnesota, she determined the medium had no significant impact on student achievement levels. Student achievement showed no statistically significant differences in test scores. It should be noted that testing methodology was not cited in this paper.

Bergman (1994) also identified no significant difference in learner achievement between host and distance sites. Bergman evaluated 237 students using the Interactive Television System (ITV) at MidTec Technical College. Bergman found older learners performed significantly better than younger learners, and female learners significantly out performed male learners.

Parrot (1995) also found while reviewing two studies of learner outcomes- one from Searcy and others (1993) in Decatur, Alabama at Calhoun Community College, and the other from Nixon (1992) from the Community Junior Quarterly of Research and Practice- there was no statistically significant difference in grade point averages (GPA's) between the host and distance learners. Both the Searcy and others (1993) and Nixon (1992) studies used t-tests to determine there was no statistical significance in performance for both the host and distance learners.

Phipps and Merisotis (1999) review of the current research on Distance Learning in Higher Education questioned the overall quality of previous research that would render previous study results inconclusive. They base their conclusions on the following: 1) the research reviewed does not attempt to control extraneous variables-thus not showing "cause & effect"; 2) most studies do not use actual subjects; 3) validity and reliability of the test instruments used are questionable; 4) many studies do not adequately measure attitudes of learners and faculty. Research gaps Phipps and Merisotis (1999) identified

included: 1) research focusing on learner outcomes for individual courses rather than entire academic programs; 2) not taking into account differences among learners; 3) not explaining the "drop-out" rates for distance education being higher; 4) different learning styles; 5) looking at impact of individual technologies versus the interaction of multiple technologies; 6) not including a theoretical or conceptual framework; and 7) not adequately addressing the effectiveness of the use of digital libraries and their potential limitations. All these areas certainly need to be addressed in future research. The results of this field study in documenting learner performance for an entire program addressed one of the "gaps" noted by Phipps and Merisotis (1999)--i.e., to research learner outcomes not for individual courses, but for an entire academic program.

Learner Outcomes - Allied Health

Allied health occupations share similarities. Allied health care workers need to demonstrate assessment and critical care decision-making skills, compassion for the patient, and the ability to perform a variety of technically demanding skills under pressure. Patient's overall health and their lives could be jeopardized if inaccurate assessments, decisions or care are implemented during patient treatment. The review of published literature documenting learner performance in Allied Health Programs should also be considered.

Learn (1994) reported learners at the College of Nursing University of New Mexico (UNM) program evaluation showed learners performed better at the off site facilities than those on campus. Learn (1994) discussed distance education for both nursing and pharmacy, but was primarily descriptive in nature. Issues relating to design,

planning, implementation, evaluation and outcomes along with previous learning and clinical teaching was discussed.

Major and Shane (1991) completed a study assessing two nursing programs one of which was located in Hawaii, and one in New Mexico. Both programs used distance education to deliver nursing education to distance sites. Both found there was no significant difference in learner performance between host and distance learners. Major and Shane reported the remote site learners formed cohesive groups within their environments to help decrease potential feelings of isolation as they were removed from the host learners and instructors. The researchers felt these cohesive groupings might be one of the contributing factors to distance learners successes with the use of the medium as they provided a support for each other as issues or problems arose.

Parkinson and Parkinson (1989) also reported that a Licensed Practical Nurse (LPN) program located at Weber State College, found there was no significant difference in learner performance between the host and distance sites. A t-test was used to make this determination.

While student achievement has been widely researched in health occupations, a critical concern that has been documented in the literature for both Allied Health and Dental Education is the student selection process. One of the biggest concerns documented was objectivity within the student selection process. Dietrich (1981) delineated four areas to be concerned with: (1) refining criteria on which applicants are evaluated, (2) choosing information sources whose data can be quantified, (3) transforming data and information into a measurable form, and (4) conducting evaluation of the validity and reliability of admissions criteria. Dietrich (1981) maintained the need

for accountability in health care, and the need for educators to assure the public that the best applicants are being chosen to enter into health care professions.

Kress and Dogon (1981) also maintained the need for objectivity in selection of applicants for dental school. They maintained college GPA's and specific dental aptitude tests can predict dental school performance. The third predictor used was that of the non-academic portion of the Dental Admissions Test (DAT). Their study showed that the GPA's were indicators of academic success, but that the carving dexterity score was a better indicator for clinical success. Concern was expressed for the need to assure that the public had access to the best-qualified applicants within the dental profession.

Lukken (1986) also expressed concern for selection of individuals into allied health professions and dental hygiene based on their need to be flexible and adaptable, along with being able to develop innovative and progressive approaches to problem solving. He looked to identify individuals who could demonstrate the capacity to have behavioral flexibility to adapt to changing situations. The study was concerned with identifying what factors could be predictive of these types of abilities. It was found that there was no statistical evidence, which supported cumulative GPA's, or quarterly GPA's as indicators of success in this area. He also investigated psychological androgyny as an indicator for success as a health care provider. Study results were inconclusive.

Learner Outcomes – Dentistry and Dental Hygiene

Research relating to Dentistry and Dental Hygiene Education focused on a wide variety of different topic areas all while using distance education technologies for delivery of courses or programs. These studies primarily focused on perceptions of

preparation and use of varying delivery mediums, delivery mechanisms and calibration issues and did not necessarily focus on learner performance.

Smith, Raybould, and Hardison (1998) discussed a distance-learning program in advanced general dentistry. Their program, through the University of Kentucky, primarily focused on how they can use compressed video and computers to share their program with remote areas in the state. Learner evaluation was not the focus as all the learners were at a distance and were already degreed. This study focused on an educational methodology, which allowed for delivery of educational programs for continuing education. This report was descriptive in nature, and did not document methodologies used in research.

Perry and Gerbert (1995) examined dental hygienists perceptions of preparation and importance of curriculum topics in outcomes assessments. Burke (1991) also looked at the current status and future trends in dental hygiene education. Specific areas of her research included the amount of time necessary to appropriately educate a dental hygienist today with the expansion of knowledge, which has occurred in the field in the areas of new technology, equipment, and quality assurance standards, which have been incorporated into curriculum.

Kaz (1996) focused on the application of distance education and student perception of the use of the medium. She identified students reported they would use the medium again to take other courses (not just dental hygiene courses) through the use of a survey tool. This research was presented at the American Association of Dental Schools annual Dental Hygiene Director's Conference as a poster session. Kaz's research did not evaluate learner outcomes.

Brecke's research (1997) focused on distance learner's perceptions of the education they received in a dental hygiene distance education program, and did not evaluate learner outcomes. Brecke found most students surveyed were neutral in their responses on if they would take further education using distance education technology. They acknowledged they would not have had the opportunity to receive the training they did without the use of this medium, and they had jobs they were satisfied with because of it. Perceptions of the graduates surveyed also included "lost time" on the system which was not "made up", the learners in Wausau had a distinct advantage over those at the other campuses as they received more attention from the instructors, and that they were not informed of how the education would be delivered or how to use the technology prior to enrolling in the program.

An unpublished study completed by Cralley (1996) reflected upon learner performance-was there a difference between dental hygiene host school and distance learners? Cralley identified there was a significant difference between host and distance learner's performance using a t-test in her study. Cralley also identified the distance learners performed significantly better than the host learners on the National Board of Dental Hygiene Examination (NBDHE) which is required as one of the steps to being licensed as a dental hygienist.

Olmsted (1996) found learner performance on the NBDHE showed mild to moderate correlation between GPA's and sub test scores on the Allied Health Aptitude Test (AHAT). Olmsted's study also showed strong correlation existed between GPA's and NBDHE scores. Olmsted's study did not attempt to evaluate performance outcomes of host vs. distance learners.

Schlei's study (1996) focused on the need for clinical calibration (consistency of grading) between the host and distance sites in the clinical and laboratory setting. She identified that on-going calibration is an effective and valuable means to ensure consistency of instruction and evaluation for both host and remote sites. Frequency and types of calibration activities where discussed, along with the need for faculty to continue to work together to achieve inter examiner reliability. Schlei's research also did not focus on evaluation of learner outcomes.

No other research in dental hygiene learner performance while using distance education technologies was found during the review of the literature. This field study addressed that need by replicating previous research.

# CHAPTER THREE

## Methodology

Dental Hygiene programs continue expanding by using distance technology to deliver education to cooperating colleges located at a distance from the originating school. While considerable study had occurred regarding user satisfaction and the evaluation of teaching effectiveness and methodology for educators using distance education technology, little research had been done on student success (Bergman, 1994; Cralley, 1996) when using this medium. There was a need for additional research. Completion of a comparative, longitudinal study at Northcentral Technical College would assess if National Board of Dental Hygiene (NBDHE) scores, individual and cumulative course grades, and GPA's still determined program effectiveness for delivery of dental hygiene education through the use of distance education methodology. Specifically, the use of Interactive Television (ITV) was the distance education methodology being evaluated.

The purpose of this study was to determine if distance learners who graduated from Northcentral Technical College since initial research in 1996 (Cralley, 1996) performed better on the National Dental Hygiene Board Examination (NBDHE) and had higher grade point averages (GPA's) than those who were face-to-face at the originating site (NTC).

### Instrument Design

The National Board Dental Hygiene Examination (NBDHE) instrument is composed of approximately 400 multiple choice and case based scenario questions divided into three categories: 1) scientific basis for dental hygiene practice, 2) provision

of clinical dental hygiene services; and 3) community health activities. This examination is norm referenced, and a score of 75% must be achieved for a candidate to apply for licensure to practice dental hygiene in the United States in 52 of the 53 licensing jurisdictions. The examination takes place during a nine hour time frame, which includes an hour lunch break between two four hour testing sessions. The American Dental Association whom constructs the examination determines external and internal validity and reliability; the examination's reliability was verified this past year using the Kuder-Richardson and the Decision-Consistency reliability indices. Indices results were .91 and .97, respectively.

Research Design

This comparative, longitudinal study evaluated learner performance. Specifically, the National Dental Hygiene Board Examination (NBDHE), along with grade point averages (GPA's), individual and cumulative course grades were used to determine learner performance. The purpose of this design was to determine if distance education (specifically, interactive television) was still an effective educational medium for dental hygiene program delivery. Comparisons were made between cooperating college (distance) learners and those who were face-to-face at the originating site (NTC).

The study had four null hypotheses. The null hypotheses of the study included determining the following:

Hypotheses examined during this study included the following:

1. No statistical difference in performance on the National Board of Dental Hygiene Examination (NBDHE) existed between cooperating college (distance) and host college learners.

2. No statistical difference in grades for individual or cumulative core curriculum courses existed between cooperating college (distance) and host college learners.

3. No statistical difference in grade point averages (GPA's) existed for cooperating college (distance) and host college learners.

4. No statistical difference existed between previous research findings (Cralley, 1996) and current field study findings using Interactive Television (ITV) for the delivery of dental hygiene education.

All data necessary for this study was already on file with the registrar at Northcentral Technical College. This was a comparison group study, which was quasi-experimental, involving two groups. The first group consisted of learners at the host site (NTC) and the second group consisted of the learners at the cooperating colleges (distance sites). Location was the determining factor in who was assigned to each group. Time was the field study variable.

Population

The population involved in the field study included the dental hygiene graduating classes of 1997, 1998, 1999, 2000 and 2001. These five graduating classes consisted of a total of 221 learners. While 106 learners were face-to-face at the host site, 115 learners used the interactive television system to receive didactic dental hygiene instruction. The graduating classes were composed of 217 females and 4 males, with a mean age of 25.04 at the host site and 27.64 at the cooperating colleges (distance sites). The five graduating classes analyzed included learners graduating from both the host and cooperating college schools. One hundred percent of the learners' in this population whom graduated were

used for the field study. The study variable was time- five graduating classes completed the program since the original study cohort in 1996 (Cralley, 1996).

Data Collection and Research Activities

For each of the null hypothesis tied to the study, an explanation of the method of data collection was included:

1. The National Board of Dental Hygiene Examination (NBDHE) was administered by the American Dental Association (ADA) to all dental hygiene learners during their last semester in dental hygiene programs. The NBDHE is a norm-referenced, one-day test, which includes questions from all disciplines within dental hygiene programs. Norming occurred within each graduating classes' test taking cohort. A minimum score of 75% on this norm-referenced instrument must be achieved in order to apply for licensure as a practitioner. Cumulative listings of learner's scores are sent to the dental hygiene programs following compilation at the American Dental Association (ADA). NBDHE scores were collected for both host and cooperating college (distance) learners for comparison. Only first time test taking scores were used during data collection and analysis. Scores were coded for comparison as a host or distance learner, and no student names or identification numbers were used to assure confidentiality.

2. Faculty at NTC teach all the "core" curriculum courses. A listing of these courses can be seen as Appendix A. The same grading scale was used for all core dental hygiene courses. This grading scale is located in Appendix B. A listing of the dental hygiene core curriculum courses was given to the registrar at the NTC campus. The registrar was able to provide all course grades for the dental hygiene core curriculum courses for both host and distance learners for comparison. Course grades were coded for

comparison as a host or distance learner, and no student names or identification numbers were used to assure learner confidentiality.

3. Cumulative GPA's for each learner were determined by the NTC registrar for all students at both host and cooperating college (distance) schools prior to graduation from the program. Cumulative GPA's used in this field study were the GPA's determined at that time. GPA was based on all courses taken at the post-secondary level of education. The registrar provided host and cooperating college (distance) learners cumulative GPA's. Learners' cumulative GPA's were coded for comparison as a host or distance learner, and no student names or identification numbers were used to assure learner confidentiality.

4. Effectiveness of the use of Interactive Television (ITV) as a delivery mechanism for distance education was then compared to previous "benchmark" research results (Cralley, 1996). Cralley used NBDHE scores, learner course grades, and cumulative GPA's to determine if distance education was an effective medium for dental hygiene education. Comparisons were made with her initial research.

Data for this study was placed into six separate spreadsheets, one for each graduating class (Class of 1997, 1998, 1999, 2000, 2001), and one composite spreadsheet including all five graduating classes. The purpose of using this format was to allow comparison between host and cooperating college (distance) learner performance on the NBDHE, learner course grades, and cumulative GPA's. Using this format also allowed comparison of the composite group (host vs. distance learners) to identify any potentially significant trends. Comparisons could also be made across the entire program using this methodology (Phipps and Merisotis, 1999).

Data Analysis

For each of the research hypotheses, it was appropriate to use independent group statistical t-tests to determine if any statistical significance between host and cooperating college (distance) learner performance existed. The same testing methodology (statistical t-test) was also applied to the composite group's data. Effectiveness of using distance education as a dental hygiene program delivery method was determined by comparing the study's t-test results in the areas of NBDHE performance, individual and cumulative core course grades, and cumulative GPA's to previous study findings (Cralley, 1996). The results of this field study in documenting learner performance for an entire program addresses one of the "gaps" noted in the scientific literature by Phipps and Merisotis (1999)--i.e., to research learner outcomes not for individual courses, but for an entire academic program. ANOVA should be run if significance is identified during any of the t-tests to identify if there is statistical significance between and within the specified groups.

Limitations

A limitation of the field study is each year's cohort taking the NBDHE was renormed. The sample was selected based on having confident data sources.

# CHAPTER FOUR

## Results and Discussion

Completion of a comparative, longitudinal field study was undertaken at Northcentral Technical College assessing if National Board of Dental Hygiene (NBDHE) scores, individual and cumulative course grades, and GPA's still determined program effectiveness for delivery of dental hygiene education through the use of distance education methodology. Specifically, the use of Interactive Television (ITV) was the distance education methodology being evaluated.

The purpose of this replication field study was to determine if distance learners who graduated from Northcentral Technical College since initial research in 1996 (Cralley, 1996) performed better on the National Dental Hygiene Board Examination (NBDHE) had higher grade point averages (GPA's), and higher cumulative course grades than those who were face-to-face at the originating site (NTC).

The study had four null hypotheses. Results and discussion for each of the hypothesis was addressed individually. The first of the hypotheses was to determine if no statistical difference in performance on the National Board of Dental Hygiene Examination (NBDHE) existed between cooperating college (distance) and host college learners. The results of data analysis can be seen in Table 1.

Table 1

Analysis of National Board of Dental Hygiene Examination (NBDHE) Scores by Host and Distance Learner

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 1997 | host | 29 | 81.76 | | | |
| | | | | 49 | -1.22 | 2.01 |
| 1997 | distance | 20 | 83.82 | | | |
| 1998 | host | 23 | 79.43 | | | |
| | | | | 41 | -1.80 | 2.03 |
| 1998 | distance | 20 | 81.6 | | | |
| 1999 | host | 24 | 78 | | | |
| | | | | 42 | -0.58 | 2.02 |
| 1999 | distance | [illegible] | 78.5 | | | |
| 2000 | host | 17 | 82.2 | | | |
| | | | | 41 | -0.13 | 2.02 |
| 2000 | distance | 26 | 82.42 | | | |
| 2001 | host | 14 | 79.79 | | | |
| | | | | 39 | -0.83 | 2.09 |
| 2001 | distance | 27 | 81.15 | | | |

For each of the five graduating cohorts, there was no statistical significance identified at the .05 level of confidence. Data confirmed a 95% confidence level the findings did not occur by chance, and that no statistical difference in performance existed between the host and distance learners.

The second hypothesis of the study examined if there was any statistical difference evident in grades for core curriculum courses between cooperating college (distance) and host college learners. The field study results for this hypothesis can be

seen in Appendix C- Tables 7-17. Individual course grades and cumulative dental hygiene "core" courses were analyzed. Individually, for ten of the eleven "core" dental hygiene courses offered in the dental hygiene distance education program at Northcentral Technical College, at the .05 level of confidence, no statistical significance was identified. Data confirmed a 95% confidence level that no statistical significance existed between host and cooperating college (distance) learners for these ten "core" courses. Statistical significance was identified on an individual course basis at the .05 level of confidence for one of the eleven courses, Periodontology 1 (Appendix C-Table 14). Analysis of variance (ANOVA) results at the 95% confidence level showed there was a significant difference between and within the sample means for Periodontology 1. The results of the ANOVA testing can be seen as Table 2.

Table 2

Analysis of Variance (ANOVA) for Periodontology 1

| Year | Student Location | Std. Dev. | SS | df | MS | F | p-value | F critical |
|---|---|---|---|---|---|---|---|---|
| 97-01 | between groups | .067 | 10.825 | 1 | 10.825 | 5.237 | 0.030 | 4.225 |
| | within groups | | 53.745 | 26 | 2.067 | | | |

The third hypothesis of the study examined if there was any statistical difference in grade point averages (GPA's) between cooperating college (distance) and host college learners. The results can be seen in Table 3.

Table 3

Analysis of Cumulative GPA's by Host and Distance Learner

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 1997 | host | 29 | 3.15 | 49 | -0.74 | 2.01 |
| 1997 | distance | 22 | 3.22 | | | |
| 1998 | host | 23 | 3.27 | 41 | -1.57 | 2.02 |
| 1998 | distance | 20 | 3.42 | | | |
| 1999 | host | 24 | 3.20 | 42 | -0.58 | 2.02 |
| 1999 | distance | 20 | 3.26 | | | |
| 2000 | host | 17 | 3.50 | 41 | 1.99 | 2.02 |
| 2000 | distance | 26 | 3.34 | | | |
| 2001 | host | 14 | 3.23 | 39 | 1.50 | 2.11 |
| 2001 | distance | 27 | 3.41 | | | |

For each of the five graduating cohorts, there was no statistical significance identified at the .05 level of confidence. With 95% confidence, it was determined no statistical difference in performance existed between the host and distance learners.

The fourth field study hypothesis was to determine if any statistical difference existed between previous research findings (Cralley, 1996) and current field study findings using Interactive Television (ITV) for the delivery of dental hygiene education.

In 1996, Cralley originally did find statistical significance in learner performance in Oral Anatomy & Histology, Radiography, Community Dental Health 1, Pharmacology, and General & Oral Pathology. She did not find statistical significance in Preclinic, Dental Materials, Periodontology 1 & 2, and Community Dental Health 2 or Dental Practice Management. A limitation of her study was having one year's data for analysis. Cralley used both individual course averages and cumulative course averages for the eleven dental hygiene "core" courses to make her determinations. Cralley concluded distance learners performed significantly better than host learners. The results of a comparison of all 11 of the core dental hygiene courses cumulative course averages for the past five graduating cohorts (1997-2001) identified no statistical significance. With 95% confidence, it was identified no statistical significance existed between host and distance learner performance for an accumulation of all eleven of the "core" dental hygiene curriculum courses. The data results can be seen in Table 4 below:

Table 4

Five year Analysis of Cumulative Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 89.19 | 8 | -0.775 | 2.45 |
| 97-01 | distance | 5 | 89.79 | | | |

The data supports that distance education was effective in meeting the needs of learners at four distance education cooperating college sites. The interactive television medium was considered effective for delivering distance education.

Additionally, correlational statistics identified strong correlations for both host and cooperating college (distance) learners between Grade Point Averages (GPA's) and National Board of Dental Hygiene Examination (NBDHE) scores. Correlations ranged from 0.536 to 0.836 consistently for all five cohorts. 95% confidence was used to determine correlational significance. Correlational data can be seen in Table 5.

Table 5

Five year Analysis of Correlations between GPA & NBDHE scores

| Year | Student Location | Correlation GPA/NBDHE |
|---|---|---|
| 1997 | host | .798 |
| 1997 | distance | .836 |
| 1998 | host | .536 |
| 1998 | distance | .764 |
| 1999 | host | .804 |
| 1999 | distance | .600 |
| 2000 | host | .721 |
| 2000 | distance | .635 |
| 2001 | host | .830 |
| 2001 | distance | .570 |

This data confirmed previous study findings by Olmsted in 1996.

Correlational analysis also identified very weak to weak correlation existed between age and grade point averages (GPA). Correlations ranged from -0.145 to 0.392 consistently for all five cohorts. Cralley had recommended in her study an analysis to identify if learner performance was related to age. She hypothesized older learners might perform better than younger ones. 95% confidence was used to determine correlational significance. The results are exhibited in Table 6 below:

Table 6

Five year Analysis of Correlations between Age and GPA

| Year | Student Location | Correlation | Age/ GPA |
|---|---|---|---|
| 1997 | host | | .230 |
| 1997 | distance | | .054 |
| 1998 | host | | .080 |
| 1998 | distance | | .259 |
| 1999 | host | | -.145 |
| 1999 | distance | | .303 |
| 2000 | host | | .189 |
| 2000 | distance | | .392 |
| 2001 | host | | -0.65 |
| 2001 | distance | | -0.57 |

# CHAPTER FIVE

## Summary, Conclusions, and Recommendations

### Summary

Dental Hygiene programs continue expanding by using distance technology to deliver education to cooperating colleges located at a distance from the originating school. While considerable study had occurred regarding user satisfaction and the evaluation of teaching effectiveness and methodology for educators using distance education technology, little research had been done on student success (Bergman, 1994; Cralley, 1996) when using this medium. Since Cralleys' original research in 1996 there have been five graduating classes from Northcentral Technical College's dental hygiene program, which consisted of a total of 221 learners. While 106 learners were face-to-face at the host site, 115 learners used the interactive television system to receive didactic dental hygiene instruction. The graduating classes where composed of 217 females and 4 males, with a mean age of 25.05 at the host site and 27.64 at the cooperating colleges (distance sites). Completion of a comparative, longitudinal study at Northcentral Technical College assessed if National Board of Dental Hygiene (NBDHE) scores, individual and cumulative "core" course grades, and GPA's still determined program effectiveness for delivery of dental hygiene education through the use of interactive television as a distance education delivery mechanism.

Additionally, this study repeated previous research methodology in the area of student performance on known academic benchmarks (GPA's, NBDHE and course grades) while using interactive television as a distance education methodology to deliver didactic content for an entire academic program. The purpose of this study was to

determine if distance learners who graduated from Northcentral Technical College since initial research in 1996 (Cralley, 1996) performed better on the National Dental Hygiene Board Examination (NBDHE) and had higher grade point averages (GPA's) than those who were face-to-face at the originating site (NTC). Additionally, correlation analysis was employed to examine existing relationships between grade point averages (GPA's) and National Board of Dental Hygiene Examination (NBDHE) scores, and age and grade point averages (GPA's). This field study also addressed a research gap identified by Phipps and Merisotis (1999) to look at learner outcomes not just for individual courses, but for an entire academic program.

Conclusions

The following conclusions based on the field studies' null hypothesis were drawn based on the results of the statistical analysis:

1. The first of the hypotheses was to determine if no statistical difference in performance on the National Board of Dental Hygiene Examination (NBDHE) existed between cooperating college (distance) and host college learners. There was no statistical difference identified between host and cooperating college (distance) learner's performance on the National Board of Dental Hygiene Examination (NBDHE) for five cohort groups (1997-2001). The research-identified performance was statistically the same whether the learners were at the host or distance site. In making this determination, it was important to note distance education, specifically the use of Interactive Television (ITV), was a viable alternative educational methodology for the delivery of allied health education.

2. The second hypothesis of the study examined if there was any statistical difference evident in grades for core curriculum courses between cooperating college (distance) and host college learners. Ten of eleven "core" dental hygiene courses did not show statistical significance in performance between the host and cooperating college (distance) learners. The data supported the conclusion that, at the 95% level of confidence, performance for ten "core" dental hygiene courses was the same between the student groups. Statistical evidence supporting the cooperating college learners performed significantly better than host learners for five cohort groups (1997-2001) existed for only one dental hygiene "core" curriculum course-Periodontology 1- at the .05 level of significance. Analysis of variance (ANOVA) results at the 95% confidence level showed there was a significant difference between and within the sample means for Periodontology 1. The data supported the cooperating college learners did outperform the host school learners in that one course. However, it should also be noted that for all the other courses in the dental hygiene educational program, learners at both the host site and the cooperating college sites performed the same. Based on this statistical evidence, it can be concluded that the use of interactive television as a distance education delivery mechanism was a viable medium for delivery of education. Areas in the nation, which exhibit "shortages" of qualified and trained allied health staff, especially in dentistry and dental hygiene, could use this methodology to deliver educational programs to learners at a distance. As the lack of qualified licensed dental hygiene personnel continues to be a significant concern nationwide, other educational alternatives must be explored and employed. This field study research demonstrated that accredited educational programs can exist successfully for the delivery of allied health education-and specifically, dental

hygiene education, to address any "shortages" of trained, qualified personnel that are perceived to exist regionally in the United States. It is not necessary to pursue the route that the Kansas and Texas legislature has allowed by providing for non-accredited "on-the-job" training programs, which do not necessarily protect the health, needs or safety of clinical patients.

3. The third hypothesis of the study examined if there was any statistical differences in grade point averages (GPA's) between cooperating college (distance) and host college learners. Analysis of cumulative grade point averages (GPA's) between host and cooperating college (distance) learners identified no statistical significance in performance between the groups. For each of the five cohort groups (1997-2001), no statistical difference in performance existed. The research-identified performance was statistically the same whether the learners were at the host or distance site. In making this determination it was important to note that distance education was a viable alternative educational methodology for the delivery of allied health education. Where learners might not prefer the medium for educational delivery, their performance was not affected by its' use.

4. The fourth field study hypothesis was to determine if any statistical difference existed between previous research findings (Cralley, 1996) and current field study findings using Interactive Television (ITV) for the delivery of dental hygiene education. It was concluded that using interactive television, as a medium to deliver distance education, was effective. Learner performance was not diminished at the cooperating colleges (distance), as determined by cumulative course averages for the "core" dental hygiene courses. It was determined with 95% confidence that host and

cooperating college (distance) learners performed the same. The conclusion drawn was that interactive television as a distance education delivery mechanism can be used for expanding the delivery of allied health or dental hygiene education to areas at a distance from an established educational program with positive results.

5. Additionally, it was determined that a strong correlation existed between learner grade point averages (GPA's) and National Board of Dental Hygiene Examination Scores. Learner academic success can be predicted using these type of objective testing mechanisms, along with GPAs. As such, it might be justified to consider GPA's when determining criteria for program admissions. No correlation was identified between age and learner grade point average (GPA).

Recommendations

Based on the field study research that was conducted, the following recommendations were made:

1. Dental hygiene education should continue to be offered using interactive television as an alternative delivery mechanism. This research identified learners at cooperating college (distance) sites performed as well as those students whom are face-to-face with a didactic instructor. Interactive television was an effective means of delivering dental hygiene education, and the use of distance education should be continued. Additionally, interactive television could be used to deliver other allied health and any other educational programs in the same manner.

2. Additional research in using additional alternative delivery mechanisms should be pursued. Distance education is now being offered via Internet courses, and other "combinations" of distance education alternative delivery mechanisms. It is

recommended these other alternative delivery mechanisms and "combination systems" should be statistically analyzed to determine if learner performance is satisfactory when they are used to deliver education.

3. Additional research should also occur regarding preferred delivery styles of faculty persons and documented learning styles of learners enrolled in or considering enrolling in distance education programs. This research might identify persons for whom distance education is not the most suitable educational methodology.

4. Ongoing research to replicate this field study to determine if distance education, and interactive television, continues to be a viable alternative educational methodology to deliver allied health education to learners at a distance.

5. Statistical research to identify learner attitudes, perceptions and satisfaction with the delivery medium should be pursued.

6. Statistical research to identify faculty attitudes, perceptions and satisfaction with the delivery medium should be investigated.

7. Statistical research to identify learner and faculty attitudes, perceptions and satisfaction with the dental hygiene program at Northcentral Technical College should be documented.

8. Statistical research to determine the significance of the findings for the Periodontology 1 course should be completed. Because statistical difference was identified between and within the sample means, field study research attempting to identify why these findings occurred should be pursued.

9. The research should be published in professional journals in national education association publications, along with professional journals in the areas of

dentistry and dental hygiene, and community and technical colleges. This research documents the viability of using distance education as an alternative mechanism to deliver educational programs. Learner performance was not affected by the use of this medium.

10. The research should be presented at national educational association forums. This research validates the viability of using distance education as an alternative for delivering education. Learner performance was not affected by using the medium to receive education.

11. Results should be used and shared with all stakeholders as part of documentation of the Northcentral Technical College shared dental hygiene program and its' outcomes.

12. Results should be reported to the American Dental Association Commission on Dental Accreditation (ADA CODA) to assist in determining the effectiveness of learner performance while using interactive television as a distance education delivery mechanism.

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APPENDIX A:

Listing of Dental Hygiene Core Curriculum Courses

First Year:

Oral Anatomy & Histology

Dental Radiography

Preclinical Dental Hygiene

Dental Materials

Periodontology 1

Clinical Dental Hygiene 1

Second Year:

Periodontology 2

Clinical Dental Hygiene 2

Community Dental Health 1 & 2

General & Oral Pathology

Pharmacology

Dental Practice Management

Clinical Dental Hygiene 3

Supportive electives for the program include:

Pain Management

Dental Hygiene Transition into Practice.

APPENDIX B:

Northcentral Technical College Grading Scale

Northcentral Technical College Dental Hygiene Program Standard Four Point Grading Scale

A= 4.0

A-=3.67

B+=3.33

B- =3.0

C+ = 2.67

C =2.0

C- =1.67

D+ =1.33

D- =1.0

F =0

APPENDIX C:

Tables of Individual Core Dental Hygiene Courses

Table 7

Five year Analysis of O. Anatomy & Histology Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 86.88 | 8 | -0.813 | 2.048 |
| 97-01 | distance | 5 | 87.70 | | | |

Table 8

Five year Analysis of Radiography Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 87.6 | 8 | -1.643 | 2.048 |
| 97-01 | distance | 5 | 89.06 | | | |

Table 9

Five year Analysis of Preclinic Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 89.12 | 8 | 0.159 | 2.048 |
| 97-01 | distance | 5 | 89.06 | | | |

Table 10

Five year Analysis of CDH 1 Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 93.22 | 8 | -0.545 | 2.048 |
| 97-01 | distance | 5 | 93.58 | | | |

Table 11

Five year Analysis of Perio 2 Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 88.32 | 8 | -1.922 | 2.048 |
| 97-01 | distance | 5 | 89.76 | | | |

Table 12

Five year Analysis of Pharmacology Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 84.40 | 8 | -1.185 | 2.048 |
| 97-01 | distance | 5 | 85.12 | | | |

Table 13

Five year Analysis of G & O. Pathology Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 86.60 | | | |
| | | | | 8 | 0.170 | 2.048 |
| 97-01 | distance | 5 | 86.45 | | | |

Table 14

Five year Analysis of Perio 1 Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical | Std. Dev. | ANOVA |
|---|---|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 87.06 | | | | | |
| | | | | 8 | -2.47 | 2.048 | .067 | See table 2 |
| 97-01 | distance | 5 | 88.35 | | | | | |

Table 15

Five year Analysis of Dental Materials Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 89.00 | | | |
| | | | | 8 | 0.945 | 2.048 |
| 97-01 | distance | 5 | 88.03 | | | |

Table 16

Five year Analysis of CDH 2 Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 93.98 | 8 | -1.573 | 2.048 |
| 97-01 | distance | 5 | 95.01 | | | |

Table 17

Five year Analysis of DPM Courses Averages by Host and Distance Learners

| Year | Student Location | n | Mean | df | Calc. t-value | 2-tailed Critical |
|---|---|---|---|---|---|---|
| 97-01 | host | 5 | 94.94 | 8 | 0.167 | 2.048 |
| 97-01 | distance | 5 | 94.74 | | | |